CASE REPORT

Experience with dexmedetomidine in pediatric tubeless anesthesia for endoscopic airway surgery: A report of three cases

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ABSTRACT

Airway surgeries in children are very challenging to the anesthesiologist because of the nature of the surgeries as well as the unique characteristics of the patient population involved. While the surgeon wants a 'free and uninterrupted field' for ease of access, the anesthetist has to ensure continuous oxygenation and ventilation to a patient whose respiratory dynamics are very volatile. The challenges are compounded by the factor of the shared airway. Dexmedetomidine has emerged as a popular anesthetic agent in various settings. However, there are not many reports of its use in children for endoscopic airway surgeries as an anesthetic. The main reason limiting use of dexmedetomidine in children is its common side effects of bradycardia and hypotension, of which bradycardia can be critical in this age group.

We describe our experience with using dexmedetomidine for spontaneous respiration anesthesia in three children undergoing complex endoscopic airway surgeries.

Key words: Laryngeal disease; Laryngomalacia; Epiglottis; Dexmedetomidine; Airway management; Anesthesia, Pediatric; Anesthesia, Inhalation/methods

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INTRODUCTION

Airway surgery in the pediatric patients is associated with a difficult relationship between the surgeon and the anesthesiologist while sharing the airway in a very vulnerable patient population. While the surgeon wants a 'free and uninterrupted field' for ease of access, the anesthetist has to ensure continuous oxygenation and ventilation to a patient whose respiratory dynamics are very volatile. Newer advances in endoscopic airway surgery have added to the challenges in terms of "tubeless anesthesia" and spontaneous respiration anesthesia.[1] Traditionally, inhalational anesthesia has been a favored technique for a spontaneously breathing patient during airway surgeries. However, concerns of environmental pollution and provision of a consistent depth of anesthesia, led to exploration of other avenues.[2] Dexmedetomidine is a new agent that has found many applications in the anesthetic setting. However, its use in endoscopic airway surgeries remains relatively untouched field.

We describe our experience with dexmedetomidine, which has not been widely used in the pediatric age group, to provide total intravenous anesthesia (TIVA) while maintaining spontaneous ventilation, in three children undergoing endoscopic airway surgeries. Informed parental consent was taken in each case for publishing the data.

CASE REPORT 1

Four month old baby, weighing 5 Kg with laryngomalacia presented for epiglottopexy. He had history of repeated episodes of pneumonia. His SpO_2 was 71-75% on room air, which improved to 92-95% with oxygen supplementation. Surgical intervention required a clear uninterrupted airway. Monitoring was established with ECG, pulse oximeter and non-invasive blood pressure. An intravenous access had already been secured. Inj propofol 1 mg/kg bolus followed by an infusion of 6 mg/kg/hr, and dexmedetomidine 0.5 μg/kg bolus over 10 min followed by infusion of 0.3 μg/kg/hr were started. Peri-operatively, spontaneous respiration was maintained and oxygen supplemented by insufflating through a nozzle introduced alongside the suspension laryngoscope. The depth of anesthesia was maintained with boluses of 2.5 mg ketamine to prevent significant movements. Intra-operatively, no bradycardia or hypotension occurred. SpO_2 was maintained at 92-95% with oxygen supplement. The procedure lasted for two hours, at the end of which the child was intubated and shifted to pediatric intensive care unit (PICU) for overnight ventilation.

CASE REPORT 2

An 11 months old girl, weighing 4 kg, with post kernicterus sequelae of global developmental delay presented with history of recurrent choking episodes and lower respiratory infections. Diagnostic laryngoscopy had revealed laryngomalacia and she was planned for supraglottoplasty. Anesthesia was induced with sevoflurane-oxygen mixture and basic monitoring was established. After intravenous access, dexmedetomidine bolus of 0.5 μg/kg over 10 minutes followed by infusion of 0.3 μg/kg/hour, and propofol infusion at 6 mg/kg/hour were used to maintain spontaneous respiration. Propofol in intermittent boluses of 5 mg was administered twice at the earliest suggestion of a light plane of anesthesia as mentioned above. At the end of the procedure which lasted for one and half hours, the child was intubated and shifted to PICU. Although she self-extubated a day later, she required respiratory support via nasopharyngeal airway for a week until she could be shifted back to the ward on nasal prongs.

CASE REPORT 3

A six year old boy gave history of an earlier accidental fall which required hospitalization and intubation for 6 days. Subsequently he was diagnosed to have subglottic stenosis. He had undergone tracheal resection with end to end anastomoses earlier and now was planned for balloon dilatation of the trachea. TIVA was provided with infusions of propofol 1 mg/kg bolus followed with 6 mg/kg/hr, fentanyl 1 μg/kg/hr and dexmedetomidine 1 μg/kg loading dose followed by 0.5 μg/kg/hr. Zero degree endoscopy was done which revealed posterior tracheal sutures from previous surgery occluding the airway. These were removed and dilatation was done using 6 mm balloon at 100 psi. Additional fentanyl 1 μg/kg and ketamine 1 mg/kg was given at this time to cover the increased stimuli. At the end of the procedure for one and half hours, the child was shifted to recovery room uneventfully and subsequently to the ward.

All the children received glycopyrrolate to decrease airway secretions and dexamethasone to reduce airway edema. 2% lignocaine was sprayed on the vocal cords prior to introduction of the suspension laryngoscope. Oxygenation was maintained in all the patients using the same technique as described in case 1.

DISCUSSION

Dexmedetomidine, an upcoming agent in anesthesia and critical care setting, is an FDA-approved drug for use in adults. However, it is also being widely used as an off-label drug in many pediatric settings. Most reports on the use of dexmedetomidine in children are on its application for sedation in the PICU, procedural sedation both for non-invasive and invasive,[3,4] prevention of emergence delirium following anesthesia, and awake craniotomies.[5-7] Although of late, it has also found an application in adult endoscopic airway surgeries, literature is scant on its use in pediatrics undergoing airway surgeries.

The main reason limiting use of dexmedetomidine in children is its common side effects of bradycardia and hypotension, of which bradycardia can be critical in this age group. Their incidence in adults is around 25%, although in pediatric age group, it has not been fully studied.[8] These effects are dose dependent. Ohata et al has reported the use of dexmedetomidine in an adult patient undergoing microlaryngeal surgery with higher doses resulting in hypotension.[9] Ramsay et al also reported dexmedetomidine as the only agent for airway surgeries with similar effects when higher doses were used.[10] On the other hand, Shukry et al has reported negative hemodynamic effects when dexmedetomidine was used as the sole anesthetic in lower doses for children undergoing laryngoscopy and bronchoscopy.[11] Considering that endoscopic airway surgeries are longer, cause continuous stimulus and need better surgical conditions, we feel adding other anesthetic agents is necessary to provide deeper planes of anesthesia, when aiming to lower dexmedetomidine doses to avoid its adverse hemodynamic effects. Nonetheless, the requirements of these agents are probably reduced because of the sedative property of dexmedetomidine which augments the depth of anesthesia when used synergistically with agents like propofol. All our patients were on a combination, which helped reduce the total amounts of each agent administered. None had any bradycardia or hypotension, in part because of the lower doses used, and also possibly due to the higher degree of continuous stimulus which is characteristic of this group of surgeries. Our first two patients were smaller than the third patient. Therefore, we used dexmedetomidine in the lower loading and maintenance doses to prevent unwanted bradycardia. As the third patient was older, we expected fewer problems and therefore used higher doses.

Various agents have been studied for TIVA, and remifentanil has been thus far regarded as an ideal agent.[12] However, it has been noted to cause cessation of spontaneous ventilation in children.[13] This can be rather disadvantageous when providing tubeless anesthesia because it mandates interruption of the surgery. The most attractive feature of dexmedetomidine which makes it a suitable option in this setting is the preservation of spontaneous ventilation while providing amnestic and sedative functions.[5]

Comparing dexmedetomidine and remifentanil for flexible bronchoscopy and foreign body removals, dexmedetomidine was found to have lower desaturation episodes as well as no apneic episodes.[14,15] Hence in the setting of endoscopic airway surgeries with an uninterrupted airway, a spontaneously breathing patient would offer definite benefit of maintaining oxygenation. Additionally, the key factor to providing anesthesia for these cases is the maintenance of adequate depth without causing respiratory depression, as airway stimulation during light planes of anesthesia can cause laryngeal or bronchial spasms. This can be reasonably achieved with our technique. Another important property of dexmedetomidine that can be advantageous in this group of surgeries is its opioid sparing effect. Gurbet A et al reported the benefits of dexmedetomidine with respect to post-operative reduction in morphine requirements in patients undergoing laparotomies.[6] After pediatric airway surgeries, a reduced opioid requirement in the post-operative period is desirable to avoid the respiratory complications that follow in the wake of opioid administration.[7]

One of the other disadvantages of using dexmedetomidine as a mainstay anesthetic is due to its longer half-life of 2 hours which can lead to delayed awakening. However, the fact that many airway surgical cases are electively ventilated, due to the risk of laryngeal oedema, offsets this disadvantage. With the doses we used, some amount of patient movement occurred more frequently than seen with higher doses. However, none of these were disruptive to the surgeon, as any tachycardia or hyperventilation was assumed as indicating an imminent sign of coughing or bucking, and was immediately treated with boluses of propofol, fentanyl or ketamine, as described.

CONCLUSION

In conclusion, in the setting of complex endoscopic airway surgeries while offering tubeless anesthesia, dexmedetomidine when used in combination with other agents offers definite advantages. These are: (a) maintenance of spontaneous breathing while providing adequate surgical plane, (b) maintenance of airway dynamics which is a key component of airway surgeries, (c) minimal desaturation due to airway mishaps, (d) minimal unwanted movements causing interruption of surgery, (e) stable hemodynamics, and (f) opioid sparing effect. Nonetheless, further studies will be required before definite conclusions can be made on the ideal doses of these drugs when used in synergy to provide a perfect balance between anesthesia preventing awareness and anesthesia resulting in cardio-respiratory side effects.

Conflict of interest: None declared by the authors

Author contribution:

SMT: Peri-operative anesthetic management of the patient, concept, design, drafting and editing of the manuscript

GG: Peri-operative anesthetic management of the patient, concept, design, drafting and editing of the manuscript

SRS: Pre-operative assessment, concept, design, drafting and editing of the manuscript

ST: Concept, design, drafting and editing of the manuscript

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> "It must be considered that there is nothing more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things."
>
> *Machiavelli*